认真总结我国大科学工程艰辛历程和成功经验, 加快推进我国高能物理大科学工程的顺利实施

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新中国成立 70 年来, 我国在国防、科学、技术、工业、经济、社会等方面取得了举世瞩目的发展。回顾和总结我国独特的发展历史和成功经验, 对我国实现党中央制定的“两个一百年”战略规划具有重要意义, 对我国制定和实施“十四五”及之后长远发展计划具有重要意义。

自 20 世纪 50 年代起, 我国充分发挥顶层布局设计和决策机制及举国体制的优越性, 从顶层布局设计上抓住“两弹一星”和核潜艇等军事科学技术工程这一龙头, 打下了我国在基础研究、科学技术、工业体系、人才培养和国际合作等方面的坚实基础。改革开放以后, 20 世纪 80 年代初, 党中央抓住科学大工程这一龙头积极开展与美国的国际合作, 建成了我国第一个大科学工程装置——北京正负电子对撞机, 为我国进入大科学工程时代奠定了坚实基础, 在科学基础研究领域方面补上了短板, 培养了大批科学家, 带动了一大批高新技术的发展, 为今后在基础科学研究方面走到世界前列打下了重要基础。刚进入 21 世纪时, 党中央又抓住国际热核聚变实验堆计划(International Thermonuclear Experimental Reactor, ITER), 积极参与国际合作, 取得了重要合作成果, 成为我国国际合作的成功典范。

2015 年 10 月, 党的十八届五中全会提出了“积极提出并牵头组织国际大科学计划和大科学工程”的战略发展要求。2016 年 8 月 18 日, 全国政协召开了以“国际科技合作和大科学工程”为主题的双周协商座谈会。2018 年 1 月 23 日, 中共中央总书记、国家主席、中央军委主席、中央全面深化改革领导小组组长习近平主持召开中央全面深化改革领导小组第二次会议, 审议通过了《积极牵头组织国际大科学计划和大科学工程方案》。会议强调, 牵头组织国际大科学计划和大科学工程, 要按照国家创新驱动发展战略要求, 以全球视野谋划科技开放合作, 聚焦国际科技界普遍关注、对人类社会发展和科技进步影响深远的研究领域, 集聚国内外优秀科技力量, 量力而行、分步推进, 形成一批具有国际影响力的标志性科研成果, 提升我国战略前沿领域创新能力和国际影响力。2018 年 3 月, 国务院出台了《积极牵头组织国际大科学计划和大科学工程方案》。

高杰 中国科学院高能物理研究所研究员, CEPC 机构委员会副主席, CEPC 加速器负责人, 亚洲直线对撞机指导委员会主席, ICFA 直线对撞机理事会理事, 中国人民政治协商会议第十一、十二、十三届全国委员会委员。

我国科学家基于我国相关领域的发展基础与国际相关领域的发展趋势提出了一些相应的重要建议。例如, 我国科学家于 2012 年 9 月首次提出建造未来大型环形正负电子对撞机国际合作大科学计划(Circular Electron Positron Collider, CEPC)^[1,2]。周长为 100 km 的环形正负电子对撞机 CEPC 旨在研究描述物质深层科学规律的标准模型中最为重要的基本粒子——希格斯玻色子, 进而探索宇宙构成的最为深层的科学规律。CEPC 概念设计报告(Conceptual Design Report, CDR)于 2018 年 11 月 14 日正式对外发布(加速器: http://cepc.ihep.ac.cn/CEPC_CDR_Vol1_Accelerator.pdf; 探测器物理: http://cepc.ihep.ac.cn/CEPC_CDR_Vol2_Physics-Detector.pdf)^[3,4]。2019 年 1 月, CEPC 正式进入技术设计报告(Technical Design Report, TDR)阶段^[5]。科学家们希望 CEPC 在“十四五”期间开工建设, 2030 年左右建成并投入运行, 并通过 CEPC 打造世界一流的科学中心。

CEPC 大科学工程将是人类有史以来在地球上所建造的规模最大的科学实验装置, 其设计、预研、评审、立项、建设和运行都是前所未有的。2020 年是“十三五”的收官之年, 也是“十四五”的布局之年, 在这重要的历史节点, 有必要认真回顾我国建国以来第一个大科学装置的提出、论证、预研、立项、建设和运行的艰辛历程和成功经验, 加快推进我国高能物理大科学工程的顺利实施^[6]。

中国科学院院士, 2011 年度国家最高科学技术奖获得者, 我国粒子加速器事业的开拓者和奠基人之一, 北京正

负电子对撞机总设计师谢家麟先生^[7]于 1993 年撰写的题为“关于北京正负电子对撞机方案、设计、预研和建造的回忆片段——写于建所 20 周年”的文章([http://www.ihep.cas.cn/](http://www.ihep.cas.cn/kxcb/khsl/201006/t20100621_2885057.html)

[kxcb/khsl/201006/t20100621_2885057.html](http://www.ihep.cas.cn/kxcb/khsl/201006/t20100621_2885057.html)), 详实地回顾和记录了北京正负电子对撞机的历史, 是我国科学史上的宝贵资料, 对我国高能物理的未来发展极具参考价值。

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Summary for “认真总结我国大科学工程艰辛历程和成功经验, 加快推进我国高能物理大科学工程的顺利实施”

Recalling of the histories and success experiences of Chinese large science projects, speeding up the realization of high energy physics large project in China

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In January 2018, the China Reform and Development Committee (led by President Jinping Xi) had the meeting, and passed the plan of “Chinese Initiated International Large Scientific Plan and Large Scientific Project”. In March 2018, it was released by Chinese government. The 14th five years plan will start in 2021 and it is very important to have a historical review of China’s large science projects in order to help in future large science projects’ planning and implementation, such as Circular Electron Positron Collider (CEPC), as Higgs factory proposed in September 2012 by Chinese scientists after the Higgs boson was discovered on July 4, 2012 at CERN on Large Hadron Collider (LHC).

In November 2018, the Conceptual Design Report (CDR) of CEPC was released formally and Technical Design Report (TDR) phase started in 2019. It is planned that CEPC TDR will be completed at the end of 2022 and CEPC will be proved by Chinese government during 14th five year plan and completed around 2030.

As China’s first large science project, Beijing Electron Positron Collider (BEPC), which was completed in October 1988, its success and experiences are very precious and useful for the realization of CEPC. In 1993, the year of 20th anniversary of Institute of High Energy Physics (IHEP), Chinese Academy of Sciences (CAS), Professor Jialin Xie, Academician of CAS and the first director of BEPC, has written an article recalling the planning, design, R&D and construction of BEPC. In this article, Jialin Xie recalled firstly the Beijing Proton Synchrotron (BPS), so called “87 Project”, in late 1970’s, which was a 50 GeV synchrotron, and Jialin Xie was the project leader of BPS. During BPS planning and R&D, many trips were to Fermi National Accelerator Laboratory (FNAL), Brookhaven National Laboratory (BNL) and CERN.

At the end of 1970’s, due to Chinese economy situation, BPS was suspended. During a collaboration meeting initiated by Professor T. D. Lee of Columbia University and Nobel Prize winner in 1957, between China and USA held at FNAL in March 1981, Professor Wolfgang K. H. Panofsky from SLAC proposed to Chinese delegation a 2.2 GeV electron positron collider instead of proton synchrotron as BPS. After careful discussions among scientists and the following evaluations from CAS, it was finally decided that China will build Beijing Electron Positron Collider, so called BEPC.

BEPC was started in 1984 and completed in October 1988. In the article of Jialin Xie, he recalled many detailed difficulties in design, R&D and construction phases, and many supports from international collaboration with US scientists and government under China-US scientific collaboration agreement. This article revealed many decision making process, design philosophy, technology choice and R&D issues, team training, project management in time and cost controls, etc. He also recalled the doubts and objection voices towards BEPC.

BEPC has not only laid a solid ground but also accumulated many precious experiences for the high energy physics and many other large science projects which follow in China. By recalling, keeping and carrying forwards these precious experiences and pioneering spirits, it is believed that CEPC as a successor of BEPC, will be realized successfully in the future.

In addition to high energy physics project CEPC, other two long term key directions are exploration to Manned Mars Project and Chinese Fusion Experimental Test Reactor (CFETRE), and three of them should be the strategic parallel Chinese large science and technology projects in the future.

Beijing Electron Positron Collider, Institute of High Energy Physics, Circular Electron Positron Collider, Higgs factory, Manned Mars Project, Chinese Fusion Experimental Test Reactor

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